

PAYLOAD FLIGHT HAZARD REPORT		a. NO:	AMS-02-F18
b. PAYLOAD Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE:	II
d. SUBSYSTEM:	All	e. HAZARD GROUP:	Loss of Orbiter, Loss of ISS
		f. DATE:	May 22, 2006
g. HAZARD TITLE: Rapid Safing/Payload Reconfiguration		i. HAZARD CATEGORY:	CATASTROPHIC X CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS: NSTS 1700.7B and ISS Addendum, 202.4a, 202.4b, 202.4c (ISS only), 205			
j. DESCRIPTION OF HAZARD: Operations or configurations of the AMS-02 may impede critical operations of the ISS or Orbiter. These include: Inability to close Orbiter Payload Bay Doors, Reconfiguration to that precludes ISS orbit boost or inability to return at end of life.			
k. CAUSES			
<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">(list)</div> <div> 1. Preclude closure of Payload Bay Doors/Orbiter Return 2. Configuration precludes ISS Operation such as reboost/EVA 3. AMS-02 Reconfiguration precludes safe return 4. Configuration requirement for planned ISS Service Loss </div> </div>			
o. APPROVAL		PAYLOAD ORGANIZATION	
PHASE I			
PHASE II			
PHASE III			
		SSP/ISS	

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l. HAZARD CONTROL (CONTROL), m. SAFETY VERIFICATION METHODS (SVM), n. STATUS OF VERIFICATIONS (STATUS)			OPS CONTROL
1. CAUSE: Preclude closure of Payload Bay Doors/Orbiter Return			
<p>1.1 CONTROL: The AMS-02 design does not contain any mechanisms or structures that protrude through the Orbiter payload bay door dynamic envelop. Payload bay doors can be closed without physical constraint imposed by the AMS-02.</p> <p>1.1.1 SVM: Review of AMS-02 Design.</p> <p>1.1.2 SVM: Analysis of Dynamic Envelop intrusions.</p> <p>1.1.1 STATUS: Open. AMS-02 outer mold line model reviewed and all close clearance points identified through the process described in NSTS 37329 Appendix Q.</p> <p>1.1.2 STATUS: Open. Close clearance points included in AMS-02 dynamic math model. Most recent DCLA results show no intrusions into dynamic envelope. Points will continue to be monitored in future analyses.</p>			
<p>1.2 CONTROL: The AMS-02 design does not require a specific configuration of AMS-02 systems (including ROEU connection) to safely return to the ground. Note: Valves designated DV15(A-D) are required only to minimize hardware element turnaround operations.</p> <p>1.2.1 SVM: Review of Design.</p> <p>1.2.1 STATUS: Open Cryosystem review of design for safe return configuration documented in Memo ESCG-4390-06-SP-MEMO-0004 dated 06 March 2006 from AMS-02 Chief Engineer Chris Tutt.</p>			
<p>1.3 CONTROL: The AMS-02 does not need any special thermal conditioning of composite structures or other systems off of the nominal mission profile to allow for safe return.</p> <p>1.3.1 SVM: Thermal Analysis to confirm thermal condition of structure under worst case conditions.</p> <p>1.3.2 SVM: Structural Analysis to confirm adequate margin for thermal extremes of composite structures/systems.</p> <p>1.3.1 STATUS: Open</p> <p>1.3.2 STATUS: Open</p>			
<p>1.5 CONTROL: The AMS-02 is safe to return only with all PRLAs and the Active Keel (latch) Assembly closed. A flight rule will be in place that the AMS-02 can only return with this safe configuration. In the event that all latches cannot be closed either electrically or by EVA, the AMS-02 will have to be returned to be berthed upon the ISS until an Orbiter with</p>			S

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working latches is available to return the vehicle. 1.5.1 SVM: Structural Analysis to verify safe return with 4 of 4 PRLA and Keel Latch. 1.5.2 SVM: Review of Flight Rules. 1.5.1 STATUS: Open 1.5.2 STATUS: Open			
2.0 CAUSE: Configuration precludes ISS Operation such as reboost/EVA			
2.1 CONTROL: The AMS-02 does not reconfigure its elements in such a manner that reduces the structural strength of the AMS-02 to handle worst-case ISS loads. (NOTE: The ability to sustain ISS/Orbiter loads safely is addressed AMS-02-F01) 2.1.1 SVM: Review of design. 2.1.2 SVM: AMS-02 Structural Analysis. 2.1.1 STATUS: Open 2.1.2 STATUS: Open			
2.2 CONTROL: The AMS-02, whether operating with a charged magnet or uncharged, does not preclude translation of EVA crew down the truss past the AMS-02. For any EVA that involves the AMS-02 directly will require that the AMS-02 magnet be discharge, however would not be a time critical event and the time to discharge the magnet is not unacceptable. (Note this is specifically addressed in AMS-02-F07) 2.2.1 SVM: Review of design 2.2.2 SVM: Inspection of as built design 2.2.4 SVM: Magnetic Field Analysis 2.2.1 STATUS: Closed by MAGIK Analysis 2.2.2 STATUS: Open 2.2.3 STATUS: Open 2.2.4 STATUS: Open			
2.3 CONTROL: The AMS-02 design allows for the installation of the AMS-02 either in the Orbiter Payload Bay or upon a			

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PAS site on the ISS Truss without specific reconfiguration of the AMS-02 hardware or avionics.			
2.3.1 SVM: Review of Design.			
2.3.2 SVM: Fit Check of hardware (Shuttle).			
2.3.3 SVM: Fit Check of hardware (ISS).			
2.3.1 STATUS: Open			
2.3.2 STATUS: Open. AMS will undergo a standard fit check to the Shuttle payload bay during ground processing at KSC prior to launch. ISS Fit Check.			
2.3.3 STATUS: Closed. Memo ESCG-4390-05-SP-MEMO-0012, "Functional Testing of the Payload Attach System" dated 28 December 2005, from AMS-02 Chief Engineer Chris Tutt.			
3. CAUSE: AMS-02 Reconfiguration precludes safe return			
3.1 CONTROL: The AMS-02 does not alter its configuration to preclude return at the end of its planned residence on the ISS. Over long term operations of the AMS-02 the superfluid helium is consumed. The AMS-02 can return to the ground with any quantity of superfluid helium, including entirely empty.			
3.1.1 SVM: Structural Analysis to confirm insensitivity to pressure loading superfluid helium tank			
3.1.1 STATUS: Open. AMS-02 currently showing positive margins to completely filled, half-filled, and empty configurations for all landing events.			
3.2 CONTROL: The AMS-02 Pressure systems do not require pressure stabilization of any pressurized tanks or components (including vacuum case and helium tank)			
3.2.1 SVM: Review of Design.			
3.2.2 SVM: Structural Verification Plan.			
3.2.1 STATUS: Open			
3.2.2 STATUS: Open			
3.3 CONTROL: In the contingency return of the AMS-02 in the event the EVA release of the PAS has been used, the mechanism is design to be reassembled by reversing the release procedure. Travel limits built into the mechanisms return the mechanism to the pre-released state and preload capability. NOTE: For Orbiter return, the mechanism does not need to be returned to this configuration to structurally survive loads or stay within the Orbiter payload bay dynamic envelope,			

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<p>however reinstallation will be requested to preserve operations of the hardware.</p> <p>3.3.1 SVM: Review of Design.</p> <p>3.3.2 SVM: Structural analysis to verify positive margins.</p> <p>3.3.1 STATUS: Closed. Memo ESCG-4390-06-SP-MEMO-0001, “Mechanical Design of the Payload Attach System (PAS)”, Dated 8 January, 2006 from AMS-02 Chief Engineer.</p> <p>3.3.2 STATUS: Open</p>			
<p>3.4 CONTROL: In the event the ROEU folding bracket is folded prior to a return in the Orbiter, the ROEU folding bracket will maintain positive margins in both configurations.</p> <p>3.4.1 SVM: Structural Analysis of ROEU Folding Bracket.</p> <p>3.4.1 STATUS: Open</p>			
4 CAUSE: Configuration requirement for planned ISS Service Loss			
<p>4.1 CONTROL: The AMS-02 does not require any configuration changes to support planned Loss of Services to ensure a safe configuration or condition of the AMS-02 hardware. The AMS-02 is designed to support planned and unexpected loss of ISS Services without causing a hazard to the ISS, the crew or other payloads.</p> <p>4.1.1 SVM: Review of Design</p> <p>4.1.1 STATUS: Open</p>			
Notes:			

ACRONYMS	
AMS-02 – Alpha Magnetic Spectrometer	PAS – Payload Attach Site, Payload Attach System
DCLA – Design Coupled Loads Analysis	ROEU – Remotely Operated Electrical Umbilical
EVA – Extravehicular Activity	